Multiple Birth Rates According to Different Socioeconomic Levels: An Analysis of Four Hospitals from the City of Sao Paulo, Brazil

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This population based study compares the rates of multiple births in the 1990s in four hospitals of different socioeconomic levels. It is well known that women from higher socioeconomic groups have easiest access to infertility therapies because of greater financial resources. The hospital of lower socioeconomic level presented multiple birth rates of approximately 8 per thousand during the decade, which may be considered as the natural one. The other three hospitals presented increased rates that were positively correlated to socioeconomic level. This increase occurred mainly due to dizygotic twins and to triplets and was as high as 4.8 per thousand in 1999. Maternal age was also positively correlated to socioeconomic level for singletons as well as for twins. However, during the decade the mean maternal age increased only in the two hospitals with better socioeconomic levels. Gestational order decreased as socioeconomic levels increased, mainly for twins and triplets. The percentage of singletons with low birthweight and very low birthweight decreased as socioeconomic level increased. However, twins presented with an equal distribution in the four hospitals, indicating that better socioeconomic level did not affect the incidence of low birthweight and very low birthweight among twins. Fetal death rate decreased as socioeconomic level increased but twin/singleton fetal death ratio is three times greater in the hospital of higher socioeconomic level suggesting that even in ideal conditions of medical and hospital facilities, the mortality of twins continues to be much higher than that of singletons.

Multiple birth rates have been increasing during the last three decades, from 1.8% in 1971 to 2.8% in 1998 in the United States, presently reaching approximately 3% of all pregnancies (Kiely & Kiely, 2001). In Brazil (State of São Paulo), however, from 1984 to 1993 this rate was found to be 0.88% (Beiguelman, 1996), as estimated from a population comprising several social levels. At a high socioeconomic level, the rate reached 2.4% in the period from 1995 to 1998 (Colletto et al., 2001). The increase in this rate has been attributed not only to an upward shift of maternal age, leading to a higher occurrence of dizygotic twins (Beiguelman et al., 1996; Bulmer, 1959; Colletto et al., 2001; Kyvik et al., 1995; Nylander, 1981), but also to the increasing use of therapies for infertility and assisted reproduction technology advances (Colletto et al., 2001; Revenis & Johnson-Robins, 1999; Tough et al., 2000; Warner et al., 2000).

Historically, multiple pregnancies have been a reason for concern due to the high number of neonatal intensive care unit admissions and the high neonatal morbimortality levels (Kochenour, 2002). The perinatal mortality for twin pregnancies is four to six-fold higher than that among single fetuses, and increases proportionally to the number of products (Beiguelman & Franchi-Pinto, 2000; Kiely, 1990; Kochenour, 2002). In addition, complications may result from the low birthweight of newborns, as noticed in 50% of twin pregnancies and in 90% of triplet pregnancies, and increased risk of intrauterine growth restrictions, higher incidence of congenital abnormalities within monozygotic twins and other neonatal diseases directly related to prematurity (Martin & Taffel, 1995; McCulloch, 1988; Revenis & Johnson-Robins, 1999).

Not only the offspring can be affected; the mothers can also be subject to several complications such as premature delivery, occurring in 20 to 50% of the cases, pregnancy-induced hypertension, *placenta praevia*, premature rupture of membranes, and polyhydramnios, among others (Newton, 1986).

Monozygotic and dizygotic twins are at higher risk of sudden infant death syndrome (Beal, 1989) due to problems that may have arisen in the perinatal period, such as congenital abnormalities and respiratory diseases (Baird et al., 1998), as well as clinical and social problems such as growth and development delays (Silva & Crosado, 1985).

Taking the above statements into consideration, the present paper analyzes the occurrence of multiple pregnancies in four hospitals in the city of São Paulo, Brazil, servicing populations from different socioeconomic levels, ranging from financially disadvantaged to highly educated and affluent women, reflecting the variation in the Brazilian population.

Material and Methods

The study focused on single and multiple births which occurred in 1990, 1996 and 1999 at four hospital facilities

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servicing populations from different socioeconomic levels in the city of São Paulo. The four groups were scored as follows: group I — Very-low level: Amparo Maternal Hospital; group II — Medium-low level: Hospital do Servidor Publico Estadual; group III — High-medium level: Hospital Santa Catarina; group IV — High level: Hospital Israelita Albert Einstein. The multiple birth rates were calculated from collected data on the total number of annual births rated as single, twin, triplet, and so forth. At the same time, data were collected regarding maternal age, gestational order, and the newborns' birthweight and sex for all multiple births as well as single ones taken as controls.

These numbers included stillborn children but excluded fetuses with 500g or less at birth. These fetuses were classified as abortions, since this fetal weight corresponds to a gestational age between 20 and 22 weeks (Belitzki, 1978). The single and multiple birth rates referred to the number of these births per 1000, including live births and stillborn children. As the twins have not been classified by any available zygosity test, the frequency of dizygotic twin pairs was estimated by means of the classical Weinberg's rule.

At hospital I, 24,793 births occurred, of which 198 were twin births. The above data were collected from all twin births and from 396 single births, which occurred immediately before and after the twin ones and were used as controls. At hospital II there were 6498 births, 82 twin births, and 164 single births, used as controls. At hospital III there were 13,649 births, of which 164 were twin births, six triplet births and one quadruplet birth in 1996; the control cohort was represented by data from 343 single births. At hospital IV there were 6434 births, with 137 twin births, 18 triplet births and two quadruplet births, one in 1996 and another one in 1999. The control group was represented by 328 single births.

Table 1

Number of Singletons, Twins and Triplets and Respective Overall Rates (Per Thousand) for the Four Hospitals According to Different Socioeconomic Levels

Hospital	Years	Singletons *N*	Twins Rate (*N*)	Triplets Rate (*N*)
I	1990	7346	8.50 (63)	
	1996	8106	8.32 (68)	
	1999	9143	7.27 (67)	
	Total	24793	7.99 (198)	
II	1990	2106	11.27 (24)	
	1996	2354	12.58 (30)	
	1999	1956	14.11 (28)	
	Total	6498	10.22 (82)	
III	1990	6332	10.62 (68)	0.16 (1)
	1996	4969	11.54 (58)	0.40 (2)
	1999	2348	15.91 (38)	1.26 (3)
	Total	13819	11.55 (164)	0.44 (6)
IV	1990	2123	13.92 (30)	0.93 (2)
	1996	1947	21.06 (42)	2.51 (5)
	1999	2207	28.45 (65)	4.81 (11)
	Total	6434	21.29 (137)	2.80 (18)

Note: Group I: Amparo Maternal Hospital (very low level of socioeconomic status).
Group II: Hospital do Servidor Publico Estadual (medium-low level).
Group III: Hospital Santa Catarina (high-medium level).
Group IV: Hospital Israelita Albert Einstein (high level).

Results

Table 1 shows values for twin rates collected during the 90s, in the four hospitals attending different socioeconomic levels, and highlights a clear increase in twin rates in hospitals II, III and IV, and in triplet rates in hospitals III and IV. The rate remained approximately constant during the decade for hospital I, and, in principle, it can be considered as representative of the natural twinning rate, as these mothers cannot afford assisted reproduction therapies.

To establish the zygosity distribution within the decade as a whole, the monozygotic (MZ) and dizygotic (DZ) twinning rates for the total of the decade data in each hospital were estimated, and these results are shown in Table 2. The results highlight a clear increase in dizygotic twins, at higher socioeconomic levels. A slight increase was shown in MZ rate, although much less than that for DZ.

Table 3 shows the means and standard deviations of maternal age and gestational order within the four studied hospitals. It can be noted that maternal age increases with increasing socioeconomic level for both single and twin groups. The Kruskal-Wallis non-parametric test (K-W) shows that maternal age significantly differs for the four hospitals, both for single ($\chi^2 = 252.44$; $p = .000$) and twin births ($\chi^2 = 111.50$; $p = .000$).

The K-W test also shows that the gestational order does not differ significantly among single births ($\chi^2 = 6.99$; $p = .072$), but differs among twin births ($\chi^2 = 16.91$; $p = .001$), and decreases as the socioeconomic level increases, as can be observed in Table 3.

There was no significant difference in maternal age for triplets' mothers from hospitals III and IV, where these

Table 2

Total Deliveries and Twin Births Occurring in the Four Hospitals; Twins By Sex (MM = Male/Male, FF = Female/Female, MF = Male/Female), Dizygotic Twin Rate (DZR), Monozygotic Twin Rate (MZR) and Total Twin Rate (TR) Per Thousand

Hospital	Total	Twins	MM	FF	MF	DZR	MZR	TR
I	24793	198	78	66	54	4.35	3.63	7.98
II	6498	82	22	32	27	8.31	4.30	12.61
III	13816	164	68	47	49	7.09	4.77	11.87
IV	6434	137	40	51	46	14.29	6.99	21.29
Total	51541	581						

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Table 3

Maternal Age and Gestational Order for Singletons and Twins: Mean, Standard Deviation and Respective Kruskal-Wallis Test (χ^2)

			Maternal Age		Gestational Order	
	Hospital	*N*	Mean	*SD*	Mean	*SD*
Singletons	I	387	24.07	5.85	2.20	1.52
	II	164	27.18	6.93	1.82	1.01
	III	291	29.91	5.16	1.99	1.04
	IV	336	30.68	4.83	1.92	1.06
	K-W test		$\chi^2 = 252.44$	$p = .000$	$\chi^2 = 6.99$	$p = .072$
Twins	I	198	25.62	5.65	2.53	1.84
	II	82	28.64	5.78	2.00	1.22
	III	164	29.73	5.00	1.95	1.14
	IV	137	32.42	4.60	1.77	1.04
	K-W test		$\chi^2 = 111.50$	$p = .000$	$\chi^2 = 16.91$	$p = .001$
Triplets	I	0	—	—	—	—
	II	0	—	—	—	—
	III	6	30.67	3.58	2.00	1.10
	IV	18	30.83	5.03	1.28	0.75
	K-W test		$\chi^2 = 0.018$	$p = .893$	$\chi^2 = 2.931$	$p = .087$

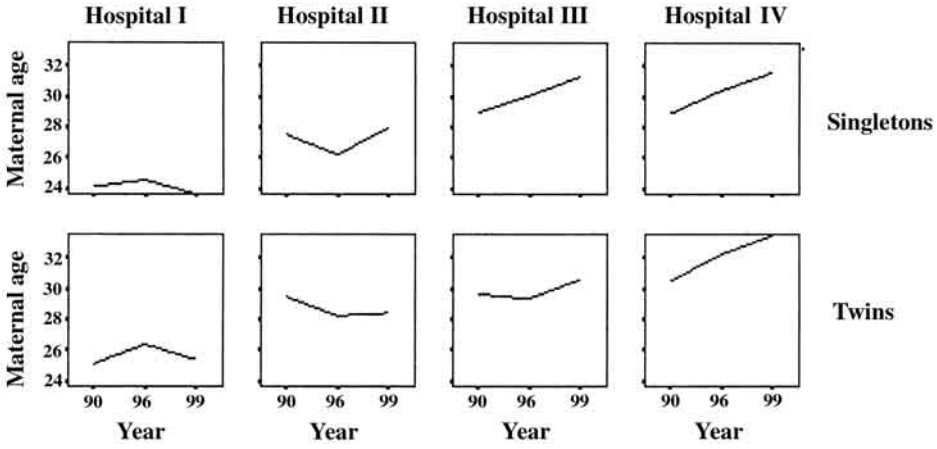

Figure 1

Mean maternal age distribution per hospital and type of delivery over the three studied years.

births occurred. For gestational order, one can observe that, although in hospital IV the triplet average is lower than that of hospital III, the significance level does not reach 0.05 ($p = 0.087$).

Figure 1 represents the maternal age means separately, per hospital, type of delivery and year of birth. It was noted that, for singletons at hospitals III and IV, there was a significant increase in maternal age during the decade, described by the Spearman non-parametric correlation test: $r_s = 0.18$; $p = .001$ and $r_s = 0.20$; $p = .011$, respectively. For the twins' mothers, the correlation was significant ($r_s = 0.22$; $p = .009$) only for hospital IV. For hospital III, the singleton mothers average age increased from 28.94 ± 4.58 in 1990 to 31.33 ± 5.97 in 1999, and that of the twins' mothers increased from 29.61 ± 4.61 to 30.59 ± 5.10. For hospital IV, the singleton mothers average age increased from 28.88 ± 4.59 in 1990 to 31.60 ± 4.85 in 1999, and that of the twins' mothers increased from 30.47 ± 3.79 to 33.46 ± 4.48. Correlations for hospitals I and II were not significant, signaling the absence of maternal age change in these two facilities.

Figure 2 shows the gestational order means separately per hospital, type of delivery and year of birth. It can be noted that in hospital III there was a significant decrease, during the decade, both in singleton ($r_s = –0.14$; $p = .012$) and twin births ($r_s = –0.20$; $p = .011$), but the same effect was not so strong in hospitals I, II and IV. It is worth mentioning, however, that the mean gestational order for twins in 1990 was already low for hospital IV (1.72), when compared to hospitals I (2.78), II (2.50) and III (2.23). Also, for hospital I, the mean gestational order remained high even during 1999 (2.35).

Table 4 shows the percentile distribution of birthweight for single, twin and triplet births in the four hospitals. It can be noted that the proportion of single births with low birthweight and very low birthweight (< 2500g) ranges from 8.1% at Hospital I to 4.6% at Hospital IV, as expected (e.g., the better the socioeconomic level, the

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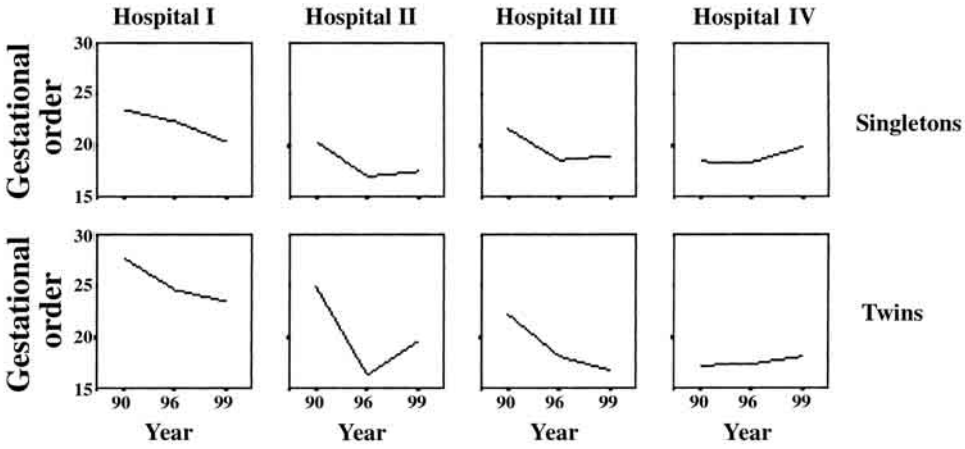

Figure 2

Mean gestational order distribution per hospital and type of delivery over the three studied years.

Table 4

Birthweight Percentage Distribution for Singletons, Twins and Triplets According to the Classical Groups: Very Low Birthweight (< 1500g), Low Birthweight (1500g–2500g) and Normal Birthweight (> 2500g)

		Singletons	Twins	Triplets
Hospital I	< 1500g	1.8	8.8	
	1500g – 2500g	6.3	52.5	
	> 2500g	91.9	38.7	
Hospital II	< 1500g	0.5	9.4	
	1500g – 2500g	7.1	46.3	
	> 2500g	92.5	44.3	
Hospital III	< 1500g	1.2	7.2	19.0
	1500g – 2500g	6.6	47.9	68.3
	> 2500g	92.3	44.9	12.7
Hospital IV	< 1500g	1.2	7.2	23.7
	1500g – 2500g	3.4	54.1	69.9
	> 2500g	95.4	38.7	6.5

Table 5

Natimortality Percentages Observed at the Four Studied Hospitals

	Hospital Year	I (%)	II (%)	III (%)	IV (%)
Singletons	1990	2.34	1.00	n.i.	0.33
	1996	1.36	0.64	0.45	0.00
	1999	0.83	0.77	0.72	0.27
	Total	1.46	0.93	0.58	0.21
Twins	1990	14.29	10.42	n.i.	5.00
	1996	5.15	3.45	2.63	2.38
	1999	2.24	7.41	1.35	2.31
	Total	7.07	4.47	2.13	2.92
Ratio twins/singletons		4.80	4.80	3.70	13.90
Triplets	1999	—	—		3.03
Ratio triplets/singletons					14.40

Note: n.i. — not informed.

lower the natimortality). For twins, however, the proportion of newborns with less than 2500g birthweight is the same for hospitals I and IV (61.3%), thus suggesting that the increase in socioeconomic level reduces the low birthweight singleton proportion, but not that for twins. As regards triplets, it was noted that the low birthweight and very low birthweight proportions were extremely high, reaching 87.3% for hospital III and 93.6% for hospital IV.

Table 5 shows the natimortality data for the studied hospitals. The collection of such data for 1990 was not possible for hospital III. The rates were calculated by dividing the number of stillborn by the total number of births (born live + stillborn) for each type of delivery. This table shows that the number of singleton and twin stillborn has apparently decreased in the course of the decade, and the twin/singleton natimortality ratio shows that in hospitals I, II and III the twins are similarly more affected than the singletons. However, the ratio is much higher for hospital IV, reaching a value three times higher than that for hospital I.

Discussion

The medical literature has been registering an increase in the twin, triplet or more births, and the consequent risk increase as regards perinatal morbimortality (Warner et al., 2000). Most of the authors find this increase to be attributable primarily to two reasons: infertility therapy (including medical treatment and assisted reproduction techniques) and an increase in maternal age (Colletto et al., 2001; Kiely et al., 1992; Martin, 1995; Warner et al., 2000).

According to the literature (Liapis et al., 1997; Warner et al., 2000), at least 50% of twins and 90% of triplets show low birthweight (< 2500g), thus usually requiring referral to the Intensive Care Unit and leading to the higher morbidity rate. In this paper, the percentage of low/very low birthweight was still higher, reaching at least 56% of the twins.

The main consequences arisen from the disproportional increase in multiple pregnancies rate include a great

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number of children born with less than 33 weeks gestational age and less than 1500g birthweight (in the present study, this rate ranged from 7.2% to 9.4%). According to Keith et al. (2000) the short-term consequences showed an almost 20-fold increase in infantile mortality among triplets, when compared to singles (190.4 × 11.2/thousand, respectively), risk of *sequelae* among the triplet population was almost three times higher than that for singles (2.9 × 1.0 /thousand) and the cerebral palsy rate increased by 16 times (26.6 × 1.6 /thousand).

It was noted, in the present work, that the twin and triplet birth rates collected in the 1990s depicted a clear increase in those hospitals attending populations from the higher socioeconomic levels. Women belonging to this social group are more likely to use infertility therapies as they are more able to afford them (Kiely et al., 1992). On the other hand, it is important to point out that the hospital I represents a population without access to the infertility therapies; therefore, this twinning rate reflects the natural rate.

A significant difference in maternal age among the four studied hospitals was also demonstrated. In hospital IV, which attends the affluent socioeconomic levels (Segre et al., 2001), the maternal age was higher and one can speculate that women delay procreation due to their professional careers, among other factors (Segre et al., 2001). Also, maternal age increase was similar for twins and triplets. Warner et al. (2000) suggested that women over 30 years of age are more likely to require infertility therapies due to a decrease in ovulation.

For both singletons and twins a trend was detected for gestational order to decrease, reaching significance in hospital III. In hospital IV this was already low at the beginning of the decade, and data for 1990 indicated a lower gestational order average for twins than singletons. It can also be noted that for hospitals I and II these mean figures for twins were higher than those for singletons, as suggested by the literature (Bulmer, 1959; Beiguelman et al., 1996), but this situation is the inverse for hospitals III and IV, where the assisted reproduction techniques are known to occur; in these cases the twin gestational order was lower than those for singletons.

There were no triplet births in hospitals I and II; these births were only observed in hospitals III and IV. The triplet rate in hospital IV had a five-fold increase from 1990 to 1999 and the twins' rate had doubled in the same period.

In hospitals I, II and III the natimortality rate was approximately four times higher for twins, as compared to singletons, while in hospital IV it was 13.9 times higher and that for triplets was 14.4 times higher, thus evidencing the high risk for these newborns, even at the hospital facilities attending the higher socioeconomic level population. On the other hand, Lambalk & van Hoof (2001) showed that twins born under assisted reproduction therapy had a higher perinatal mortality rate and very premature parturition (< 29 weeks) when compared to natural twins, which could explain, in part, the higher mortality rate in this hospital, where the higher incidence of multiple births resulted mainly from the assisted reproduction techniques.

Regarding zygosity, a DZ twinning rate increase was found as the socioeconomic levels increased, from 4.3 per thousand at hospital I to 14.4 per thousand at hospital IV (i.e., a rate three times higher). The MZ rate has also increased, although less significantly, from 3.3 per thousand to approximately 7.0 per thousand, and could be explained as result of two independent factors. First the one cannot discard a small increase due to assisted reproduction (Schachter et al., 2001), but it is believed that the more plausible explanation could be that the increase in maternal age, as the socioeconomic levels increase, would also produce an increase in the MZ rate, as speculated in another study (Colletto et al., 2001) related to prolonged oral contraceptives intake. It is possible to infer that older women have had a longer period of oral contraceptives intake. Therefore, maternal age increase would lead to an increase in not only the DZ rate, widely described in the literature since 1959 (Bulmer, 1959; Beiguelman et al., 1996), but also the MZ rate. It is important to highlight that fetal death and extremely pre-term newborn birth rates increase among monozygotic twins, added by an increase in congenital abnormalities (Revenis & Johnson-Robins, 1999; Warner et al., 2000).

It is worth noting that in this work the low birthweight and very low birthweight (< 2500g) among singletons decreased with higher socioeconomic levels. However, this was not true for twins, suggesting that the socioeconomic level has influenced the singletons' birthweight, but not that of the twins, among which the percentage of children with low/very low birthweight continued to be high (around 60%). This problem was even larger among triplets; the high socioeconomic level hospital (IV), only 6.5% of triplet twins were born with normal weight.

Conclusions

The present work was able to show the significant increase in twin (mainly DZ) and triplet births which occurred in hospitals servicing populations from high socioeconomic levels and of increased maternal age.

Taking into account the increase in the multiple birth rates in populations from better socioeconomic levels and its resulting complications, it is worthwhile to take preventive measures. Therefore, a better knowledge of these populations' behavior is needed, as well as clarifying the risks involved and acting in the most responsible manner, as far as the medical point of view is concerned.

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